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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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EXAMINER

LEE, SHUN K

ART UNIT	PAPER NUMBER
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2878

DATE MAILED: 07/30/2003

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)
	09/836,464	LIU, HUI CHUN
	Examiner	Art Unit
	Shun Lee	2878

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) Responsive to communication(s) filed on ____.
 2a) This action is FINAL. 2b) This action is non-final.
 3) Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4) Claim(s) 1-23 is/are pending in the application.
 4a) Of the above claim(s) ____ is/are withdrawn from consideration.
 5) Claim(s) ____ is/are allowed.
 6) Claim(s) 1-23 is/are rejected.
 7) Claim(s) ____ is/are objected to.
 8) Claim(s) ____ are subject to restriction and/or election requirement.

Application Papers

9) The specification is objected to by the Examiner.
 10) The drawing(s) filed on 18 April 2001 is/are: a) accepted or b) objected to by the Examiner.
 Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
 11) The proposed drawing correction filed on ____ is: a) approved b) disapproved by the Examiner.
 If approved, corrected drawings are required in reply to this Office action.
 12) The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
 a) All b) Some * c) None of:
 1. Certified copies of the priority documents have been received.
 2. Certified copies of the priority documents have been received in Application No. ____.
 3. Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
 * See the attached detailed Office action for a list of the certified copies not received.
 14) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
 a) The translation of the foreign language provisional application has been received.
 15) Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)	4) <input type="checkbox"/> Interview Summary (PTO-413) Paper No(s). ____ .
2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)	5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)
3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449) Paper No(s) ____ .	6) <input type="checkbox"/> Other: _____

DETAILED ACTION

Drawings

1. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, the plurality of doped quantum well layers and contact layers must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

2. The drawings are also objected to because:

- (a) in Fig. 2, it is unclear what well doping concentration corresponds with which curve;
- (b) in Fig. 3, units are lacking;
- (c) in Fig. 3, "Responsivitys" should probably be --Responsivity--; and
- (d) in Fig. 3, it is unclear what the plurality of curves without legend labels represent (it should also be noted that the curve legend "90" is not explained).

A proposed drawing correction or corrected drawings are required in reply to the Office action to avoid abandonment of the application. The objection to the drawings will not be held in abeyance.

Specification

3. Applicant is reminded of the proper language and format for an abstract of the disclosure.

Art Unit: 2878

The abstract should be in narrative form and generally limited to a single paragraph on a separate sheet within the range of 50 to 150 words. It is important that the abstract not exceed 150 words in length since the space provided for the abstract on the computer tape used by the printer is limited. The form and legal phraseology often used in patent claims, such as "means" and "said," should be avoided. The abstract should describe the disclosure sufficiently to assist readers in deciding whether there is a need for consulting the full patent text for details.

The language should be clear and concise and should not repeat information given in the title. It should avoid using phrases which can be implied, such as, "The disclosure concerns," "The disclosure defined by this invention," "The disclosure describes," etc.

4. The abstract of the disclosure is objected to because of the language. Correction is required. See MPEP § 608.01(b).

Claim Objections

5. The numbering of claims is not accordance with 37 CFR 1.75 (*i.e.*, if there are several claims, they shall be numbered consecutively in Arabic numerals).

Misnumbered claims 20 and 21 (lines 22-28 on pg. 12) have been renumbered as 22 and 23, respectively.

6. Claims 4 and 19-21 are objected to because of the following informalities:

- (a) in claim 4, "dopant concentration" on lines 1-2 should probably be --doping density-- (see "doping density" in claim 5);
- (b) in claim 19, "GigaHz" on line 2 should probably be --GHz--;
- (c) in claim 20, "GigaHz" on line 3 should probably be --GHz--; and
- (d) in claim 21, "temperature" on line 2 should probably be --temperature-- (*i.e.*, each claim begins with a capital letter and ends with a period, MPEP 608.01(m)).

Appropriate correction is required.

7. Claims 22 and 23 are objected to under 37 CFR 1.75(c), as being of improper dependent form for failing to further limit the subject matter of a previous claim. Applicant is required to cancel the claim(s), or amend the claim(s) to place the claim(s) in proper dependent form, or rewrite the claim(s) in independent form. Claims 22 and 23 are directed to a method whereas claim 19 is directed to a photodetector (it is suggested that "claim 19" should probably be --claim 21--.

Claim Rejections - 35 USC § 112

8. The following is a quotation of the first paragraph of 35 U.S.C. 112:

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

9. Claim 22 is rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention. Claim 22 recites the limitation "filtering the dark current component" which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

10. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

11. Claims 1-20 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Art Unit: 2878

The term "low" in claims 1, 8, 9, and 10 is a relative term which renders the claims indefinite. The term "low" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Thus the limitation other than low temperatures is vague and indefinite and fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "high" in claims 1, 2, 4, 8, and 9 is a relative term which renders the claims indefinite. The term "high" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Thus the limitation high absorption is vague and indefinite and fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "near" in claims 2 and 10 is a relative term which renders the claims indefinite. The term "near" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Thus the limitation near room temperatures is vague and indefinite and fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "large" in claim 4 is a relative term which renders the claim indefinite. The term "large" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Thus the limitation dopant

concentration is selected to be sufficiently large for high absorption during near room temperature operation is vague and indefinite and fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The term "substantial" in claim 9 is a relative term which renders the claim indefinite. The term "substantial" is not defined by the claim, the specification does not provide a standard for ascertaining the requisite degree, and one of ordinary skill in the art would not be reasonably apprised of the scope of the invention. Thus the limitation substantial dark current is vague and indefinite and fails to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claim Rejections - 35 USC § 102

12. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

13. Claims 1-3, 8, 21, and 23 are rejected under 35 U.S.C. 102(b) as being anticipated by Delacourt *et al.* (US 5,160,991).

In regard to claims **1-3** and **8** in so far as understood, Delacourt *et al.* disclose (Fig. 3) a quantum well infrared photodetector comprising:

(a) a plurality of quantum well layers (see 2 in Fig. 1) formed of a first semiconductor material (e.g., GaAs; column 8, line 62 to column 9, line 2) and n-type doped forming a multi-quantum well structure for providing high absorption at temperatures other than low temperatures (e.g., ambient temperature at or near

room temperature such as T = 300K; column 4, lines 40-44) and a substantial dark current is inherent in a quantum well infrared photodetector at temperatures other than low temperatures, wherein the plurality of doped quantum well layers (see 44 in Fig. 7) includes more than 10 quantum well layers (e.g., 50 wells; column 8, lines 62-66);

- (b) barriers (see 1 and 3 in Fig. 1) between the quantum well layers (see 2 in Fig. 1) formed of a second semiconductor material (e.g., Al_{0.15}Ga_{0.85}As; column 8, line 62 to column 9, line 2); and
- (c) contact layers (11, 13) for receiving current from the plurality of quantum well layers (see 2 in Fig. 1).

It is noted that cryogenic cooling is defined as temperatures <150K in the specification (pg. 4, line 15). In regard to claim 21 and claim 23 (which is dependent on claim 21 in so far as understood), Delacourt *et al.* disclose a method of detecting infrared radiation comprising the steps of:

- (a) detecting infrared radiation (column 1, line 48 to column 2, line 28) with a quantum well device absent cryogenic cooling (e.g., ambient temperature at or near room temperature such as T = 300K; column 4, lines 40-44); and
- (b) determining an intensity of the detected infrared radiation (column 7, lines 58-59).

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

- (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the

invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. Claims 9-11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991).

In regard to claims 9-11 in so far as understood, Delacourt *et al.* is applied as in claims 1, 2, and 8 above. The photodetector of Delacourt *et al.* lacks an explicit description that the contact layers comprise a third doped semiconductor. However, Delacourt *et al.* also disclose embodiments including a contact layer (13) formed by a third doped semiconductor (e.g., $1 \times 10^{17} - 5 \times 10^{18} \text{ cm}^{-3}$ n doped GaAs; column 8, line 62 to column 9, line 2) in order to obtain an ohmic contact (column 5, lines 26-28). Therefore it would have been obvious to one having ordinary skill in the art to provide a third doped semiconductor as the contact layers in the photodetector of Delacourt *et al.*, in order to obtain ohmic contacts.

16. Claims 4-6, 19, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991) in view of Liu (Semiconductor and Semimetals, Vol. 62, pg. 129-196, 1999).

In regard to claims 4-6 which are dependent on claim 3 in so far as understood, the photodetector of Delacourt *et al.* lacks that the doping density $N_d = (m/\pi\hbar^2)(2k_B T)$ of the first semiconductor material (*i.e.*, GaAs) is in the range of $1-2 \times 10^{12} \text{ cm}^{-2}$, where m is the effective mass, \hbar is the Planck constant, k_B is the Boltzmann constant, and T is the desired operating in degrees K such as room temperature. Liu teaches (third paragraph on pg. 168) that the doping density $N_d = (m/\pi\hbar^2)(2k_B T)$ of the first semiconductor material (*i.e.*, GaAs) is in the range of $1-2 \times 10^{12} \text{ cm}^{-2}$, where m is the

effective mass, \hbar is the Planck constant, k_B is the Boltzmann constant, and T is the desired operating in degrees K such as room temperature in order to maximize the detector limited detectivity. Therefore it would have been obvious to one having ordinary skill in the art to provide a doping density (e.g., $N_d = (m/\pi\hbar^2)(2k_B T) = (0.067 \cdot 9.1095 \times 10^{-31} \text{ kg}/(3.1415 \cdot 1.0546 \times 10^{-34} \text{ Js}))(2 \cdot 1.3806 \times 10^{-23} \text{ J/K} \cdot 300\text{K}) = 1.4 \times 10^{12} \text{ cm}^{-2}$) in the photodetector of Delacourt *et al.*, in order to maximize the detector limited detectivity.

In regard to claims **19** and **20** which are dependent on claim 8 in so far as understood, the photodetector of Delacourt *et al.* lacks an explicit description that the plurality of doped quantum well layers is designed for operation at frequencies above 1 GHz or 30 GHz. However, the physical characteristics of GaAs/AlGaAs are well known in the art. For example, Liu teach (pg. 176-182) that operational frequencies depend on the carrier lifetime. Therefore it would have been obvious to one having ordinary skill in the art that the photodetector of Delacourt *et al.* is operational at high frequencies (e.g., 30 GHz).

17. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991) in view of Liu (Semiconductor and Semimetals, Vol. 62, pg. 129-196, 1999) as applied to claim 6 above, and further in view of Sato *et al.* (US 5,077,593).

In regard to claim 7 which is dependent on claim 6 in so far as understood, Delacourt *et al.* is applied as in claims 9-11 above. The modified photodetector of Delacourt *et al.* lacks that the n-type dopant is Si. N-type doping for GaAs is well known

in the art. For example, Sato *et al.* teach (column 5, lines 39-44) that n-type doping for GaAs comprises Ge, S, Si, Sn, Te, or Se. Therefore it would have been obvious to one having ordinary skill in the art that the n-type doping in the modified photodetector of Delacourt *et al.* comprise a known n-type doping such as Si.

18. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991) in view of Sato *et al.* (US 5,077,593).

In regard to claim 12 which is dependent on claim 11 in so far as understood, Sato *et al.* is applied as claim 7 above.

19. Claims 13-17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991) in view of Sato *et al.* (US 5,077,593) as applied to claim 12 above, and further in view of Liu (*Semiconductor and Semimetals*, Vol. 62, pg. 129-196, 1999).

In regard to claim 13 which is dependent on claim 12 in so far as understood, Liu is applied as claims 4-6 above.

In regard to claims 14-15 which are dependent on claim 13 in so far as understood, Delacourt *et al.* also disclose that the Al fraction of the second semiconductor material (*i.e.*, $\text{Al}_{0.15}\text{Ga}_{0.85}\text{As}$; column 8, line 62 to column 9, line 2) is 10%-50%.

In regard to claims 16 and 17 which are dependent on claim 15 in so far as understood, Sato *et al.* is applied as claim 7 above.

20. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Delacourt *et al.* (US 5,160,991) in view of Sato *et al.* (US 5,077,593) and Liu

(*Semiconductor and Semimetals*, Vol. 62, pg. 129-196, 1999) as applied to claim 17 above, and further in view of *Wen et al.* (US 5,352,904) and *Brouns* (US 5,773,831).

In regard to claim 18 which is dependent on claim 17 in so far as understood, the modified photodetector of *Delacourt et al.* lacks that the third doped semiconductor material is 0.1-2 μm thick. Contact layers are well known in the art. For example, *Wen et al.* teach (column 4, lines 51-58) that the contact layer thickness should be selected to limit the electron energy loss (e.g., 0.1 to 0.15 μm thick GaAs). As another example, *Brouns* teaches (column 3, lines 27-30) that a 0.15 μm thick n-type doped GaAs contact layer is transparent to infrared radiation. Therefore it would have been obvious to one having ordinary skill in the art to provide 0.15 μm thick n-type doped GaAs layers as the contact layers in the photodetector of *Delacourt et al.*, in order to obtain infrared radiation transparent contact layers that also minimize electron energy loss.

21. Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over *Delacourt et al.* (US 5,160,991) in view of *Choi* (US 5,384,469).

In regard to claim 22 which is dependent on claim 21 in so far as understood, the method of *Delacourt et al.* lacks that the step of determining comprises the step of filtering the dark current component of the detected signal to determine an intensity of the detected infrared radiation. *Choi* teaches (column 7, lines 8-27) filtering the dark current component of the detected signal in order to detect the infrared radiation intensity with more sensitivity. Therefore it would have been obvious to one having

ordinary skill in the art to filter the dark current in the method of Delacourt *et al.*, in order to detect the infrared radiation intensity with more sensitivity.

Conclusion

22. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Shun Lee whose telephone number is (703) 308-4860. The examiner can normally be reached on Tuesday-Thursday.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, David Porta can be reached on (703) 308-4852. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 872-9318 for regular communications and (703) 872-9319 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.


CONSTANTINE HANNAHER
PRIMARY EXAMINER
GROUP ART UNIT 2878

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July 22, 2003